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MATTERS RELATING TO LIFE SCIENCES, INCLUDING SPACE MEDICINE

Methods based on the results of research in space biology and medicine

Working paper submitted by the Soviet Union

As the technology for manned space flight develops, space medicine is accumulating a considerable amount of knowledge with regard to man, his potential, health maintenance and ways of intervening in the process of adapting the body to the different conditions of space. Every space flight is achieving impressive results and furthering our knowledge. The attainments of space medicine are being used to improve health care not only in space but also on Earth.

Research into tapping the potential of space flight to improve health care and therapy is being pursued in various fields.

Reference may be made firstly to the transmission of all kinds of medical information. In order to monitor the physical condition of astronauts, a variety of methods and instruments has been developed to record and transmit to Earth by telemetry various physiological and biochemical parameters indicating the condition of various bodily systems. These enable doctors to be more or less fully informed of the state of health of astronauts who are hundreds of kilometres distant in space.

The principles of this remote diagnosis, or remote medicine, have many applications on Earth, for example, diagnosis or consultations by specialists in the case of patients far from major medical centres.

Reference may also be made to the application of experience gained from space flight to Earth medicine through the use of methods and instruments developed for

the selection and training of astronauts and for medical research in space. It should be noted that medical instruments designed to be used on board spacecraft are characterized by their small size, simplicity of operation and high degree of reliability.

1. The Argument apparatus is employed to scan the heart and major blood vessels by means of ultrasound. This makes it possible to examine the heart from the inside and to determine the condition of its chambers and major blood vessels, as well as the functioning of the valves and cardiac muscle. This portable apparatus is also used in clinics and ambulances, which vastly increases the potential for specialized diagnosis of cardiovascular disease.

2. The polyvalent portable respirator, which permits extended ventilation of the lungs, treatment of atelectasia, and the active inhalation of medical aerosols and anaesthesia, is used in resuscitation procedures and may prove of general applicability in ambulances.

3. A very varied range of medical instruments developed for research in space is currently in use in Ecosan automated mobile technical laboratories, in which medical examinations are performed on the general population with a view to recording the functional status of the body and formulating recommendations for health care and improvement. At the same time, studies are being conducted of the ambient atmosphere to detect harmful chemical substances and prepare an ecological assessment of various regions. If a comprehensive assessment of changes in health levels is conducted on the basis of examinations of a sufficiently large number of individuals living in a given industrial sector, it is possible to determine with some precision the degree to which the environment is polluted, and thus prepare a health profile (a distribution of individuals in terms of state of health) and produce maps of the medical-ecological conditions in the sector in question.

The medical evacuation apparatus used at the capsule landing-site to conduct a preliminary examination of astronauts is adaptable for use in emergencies to provide on-site emergency medical care to victims of accidents or natural disasters. The apparatus comprises several inflatable modules, equipped with the most advanced medical instruments, including those developed for research in space. Field tests in the Far North (Cape Schmidt, Chukotka) and in the Kara-Kum desert have shown that it can be used in various geographical regions under extreme conditions.

For prophylaxis against changes in the intestinal flora of astronauts on long space flights, "Lactobacterin", an anti-bacterial agent developed from a new strain of Liplantarum 38 lactobacteria, is used. The strain is representative of the intestinal automicroflora of healthy human beings, is resistant to digestive fluids and enzymes, has exceptionally high adhesiveness and is highly antagonistic to disease-producing micro-organisms. The strain is compatible with anti-bacterial preparations widely used in medical practice. Preparations can be manufactured from the strain which lend themselves to the microbial lyophilization of active lacto-bacterial antagonists. The preparation is intended for the treatment of children and adults suffering from colitis of varying aetiologies, bacterial dysfunctions resulting from the use of antibiotics, sulphamide preparations and other causes, non-specific colitis, the prophylaxis of persons convalescing from

dysentery and colienteritis, and, in obstetrical-gynaecological practice, for sanitation of the genital tracts of women suffering from genital inflammation and for pre-natal preparation during pregnancy. The agent is harmless and non-toxic, and there are no contraindications to its use.

The cardiovascular research methods used in space can be successfully applied in the diagnosis and prophylaxis of cardiovascular disease on Earth. The use of such methods for discovery of initial functional changes opens the way to prognosis in the case of unfavourable changes and makes it possible to take timely prophylactic action.

Research on the complex methods for evaluating the functional conditions of vestibulo-oculomotor interaction makes it possible to obtain objective information on the nature of oculomotor reactions, which facilitates immediate evaluation of the condition of the subject's vestibular and central nervous systems and, on that basis, prediction of the subject's capacity to carry out his professional functions: the visual observation of objects in certain situations influenced by complicated additional optokinetic and vestibular factors. The method may have applications in aviation, space, transport, underwater activities and sports medicine. In clinical medicine, the method can be used in differential diagnosis of the impairment of vestibular functions in otolaryngology, neurosurgery and neurology.

Of even broader application to Earth use are the methods worked out in space medicine for the psychological selection and preparation of people for work in extreme conditions, and the selection of groups on the basis of psychological compatibility.

Lastly, the results of the study of man in space, in conditions of weightlessness, significantly extend and deepen our knowledge of human health. In fact, it may be said that it is thanks to space activity that medical knowledge has been deepened of the mechanisms of human spatial orientation, the structure and function of the vestibular apparatus, human biomechanics and metabolism, and the cardiovascular and central nervous systems.

A great deal of experience with international cooperation has been acquired in space medicine. Together with scientists from a number of countries, Soviet specialists have carried out various experiments on Earth and in space, and have worked out research methods and procedures. For example, biomechanical research has been carried out on Soviet orbital stations on the Czechoslovak "Plasma" and "Reflotron" devices (the Beringer-Manheim Company), and the French "Echograph" apparatus for ultrasound research on internal organs, and the Polish "Physiotest" apparatus has been used for functional tests with physical loads.

What is required now is to concentrate the efforts of international society on the areas of highest priority of space research and utilization, in order to avoid duplication of effort and the unwarranted dispersal of means and efforts. The positive trend apparent in international relations in recent years towards the deepening of mutual understanding and confidence between countries unquestionably makes possible the appearance of new forms of co-operation, including the creation

of international "space markets", of which the geographic area and the number of partners involved will steadily increase. The process of uniting mankind's efforts in the peaceful utilization of space is gaining strength. The important thing is that everything done in this area should be done for the welfare and health of mankind in space and on Earth.

From this point of view, international partners should certainly be interested in the proposals put forward by Soviet specialists in space medicine, particularly the scientists of the Institute for Medico-Biological Problems of the USSR Ministry of Health, the only institution dealing with the medical security of space flight and the study of the human being in various extreme circumstances. The Institute has acquired a great deal of experience with regard to autonomic life-support systems; the organization, preparation and construction of space experiments with various biological objects; the testing of medical apparatus; and various other matters.

Firms and organizations interested in co-operation with the Soviet Union in space biology and medicine may receive detailed scientific and technical information on the instruments, apparatus, methods and means worked out by Soviet space medicine to safeguard space flight. Inquiries should be directed to the Institute for Medico-Biological Problems of the Ministry of Health of the USSR.

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